

Walpole District
Bulk Substation Transformer Outages
Distribution Supply Line Outages
Thermal Results and Remedial Switching Actions

2003 T&D OPERATING STUDY WALPOLE DISTRICT

STATION #65 MEDWAY

Medway Station #65 supplies the towns of Medway, Millis and portions of Ashland, Bellingham, Holliston, Hopkinton, Norfolk and Sherborn. In the summer of 2002 Medway Station #65 load was 51 MVA.

Medway Station #65 consists of the following transformers:

Transformer #110A: North American 24/32/40 MVA 117/14.4 kV

Transformer #110B: North American 24/32/40 MVA 117/14.4 kV

Medway Station #65 total capacity is 80 MVA. NSTAR employs summer emergency rating (cyclic capability) of 40.1 MVA for each of these two banks. Station #65's firm capacity is 40.1 MVA. Medway Station #65 has approximately 14.9 MVA of RADSEC transfer switching to adjacent stations Hopkinton #126 and Sherborn Station #274. Medway's load carrying capability is 55 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	24/32/40 MVA	48 MVA	44 MVA
110B	24/32/40 MVA	48 MVA	44 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
80 MVA	40 MVA	14.9 MVA	0 MVA	54.9 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
52 MVA	53 MVA	53 MVA	54 MVA	55 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breakers #2 and #3 in Medway 115kV ring bus

Main 110A 13.8kV Circuit Breaker

Disconnect Switch #T730

Close: ABR scheme closes 13.8V bus tie breaker automatically

Circuit Breakers #2 and #3 to restore Medway ring bus

Loss of Transformer #110B:

- Open:** Circuit Breakers #1, #4, and #7 in Medway 115kV ring bus
Main 110B 13.8kV Circuit Breaker
Disconnect Switch #T731
- Close:** ABR scheme closes 13.8V bus tie breaker automatically
Circuit Breakers #1, #4, and #7 to restore Medway ring bus

For loss of either transformer, transfer of the following DSS lines via RADSEC switches would also be required:

Medway 65-H2 to Hopkinton 126-H2 via RADSEC switch on P 12/105 for a transfer of 5.3 MVA
Medway 65-H6 to Hopkinton 126-H3 via RADSEC switch on P35/38 for a transfer of 5.8 MVA
Medway 65-1325H to Sherborn Sta #274 via SCADA controlled breaker at Sta #65 for a transfer of 3.8 MVA.

Total Transfer: 14.9 MVA

Summary of Concerns:

1. Inadequate transformer capacity under contingency conditions (2007)
2. Radial line 65-H5 overloaded under normal conditions (2008)

Without any significant major development projects during 2002-2008, the Medway Supply region is projected to experience very meager load growth; approximately 1% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2007 for a single-contingency outage of either transformer 110A or 110B, Medway Station #65 will exceed the load carrying capability (1% over LTE, 0.3 MVA load risk).

Distribution Systems
DSS Lines

The Ashland Line Group consists of two DSS lines, 65-1325H and 239-1429H. The line group is a loop supply between Sherborn Station #274 and Medway Station #65. There are 4 distribution circuits tapped off the 65-1325H. The line group supply supplies customer stations #239 and #401. Upon the loss of either of the DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The following table provides details on the Medway line 65-1325H.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
65-1325H	38%	0%	0	0%	0

Loading on Medway DSS line.

14 kV Distribution Circuits

Five of the six distribution circuits fed from Medway #65 will have adequate capacity. By 2008 one circuit 65-H5 is projected to reach 100% of its normal capacity with all lines in service. There are no 4 kV stations/circuits fed from this station.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
65-H1	80%	81%	87%
65-H2	45%	45%	47%
65-H3	80%	82%	87%
65-H4	75%	78%	83%
65-H5	90%	93%	100%
65-H6	85%	87%	90%

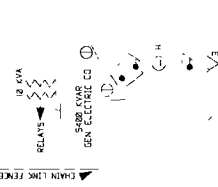
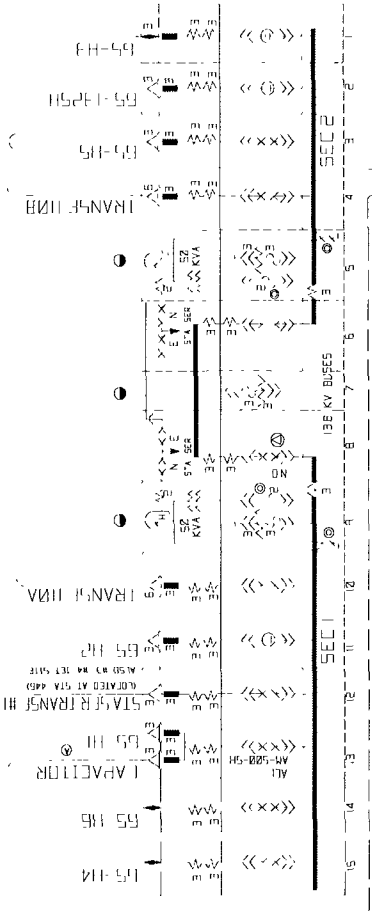
Loading on 14 kV distribution circuits.

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Medway supply region. The primary focus of the plan is to expand Walpole Sta #146 by installing a fourth transformer. Walpole Station #146 with 100 MVA of firm capacity has ample transformer capacity to be the foundation of an integrated plan to support the Walpole-Medway region's load beyond 2008. There are two new spare feeder positions at Walpole Station #146 that can support installation of new distribution circuits to relieve the heavily loaded distribution circuits in the Medway region and to increase transfer switching between Walpole and Medway. Alternatives include increase the capacity of the lines by reconductoring and cascading load transfers to adjacent circuits in the Medway supply region.

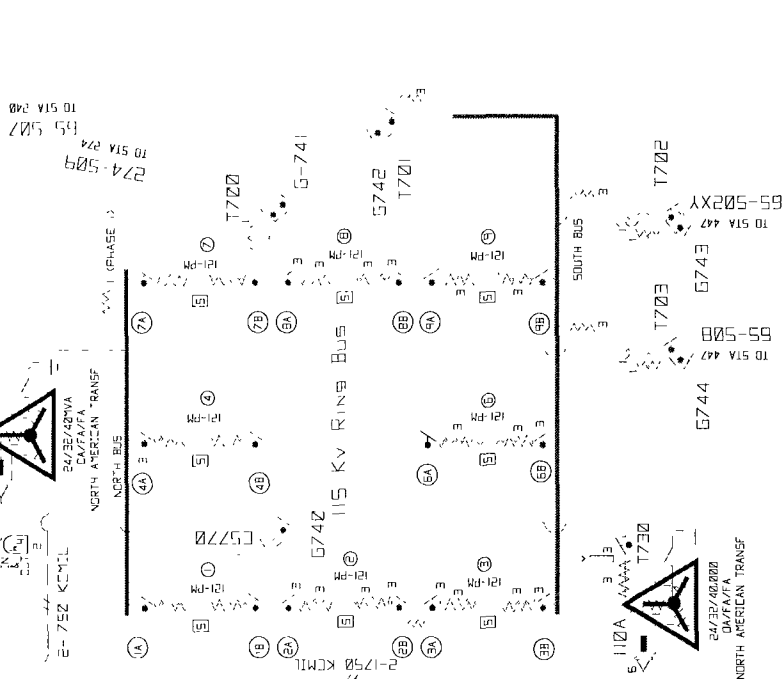
Action	Year needed	Cost
⇒ Extend a distribution circuit from Walpole#146 into Millis center supports a permanent load transfer of 10 MVA to Walpole #146 and relieve Medway distribution circuits or reconductor two Medway Station #65 distribution circuits or load transfers to adjacent circuits in the Medway supply region.	2008	TBD

STATION 65
MEDWAY RING
WEST ST NEAR VILLAGE ST
WEST MEDWAY
TEL: (528)372-4362



NOTES:

- KEY INTERLOCKED TO STA. SEC. 2 BUS. MUST BE OPEN TO RELEASE THE KEY TO PERMIT THE PRIMARY FUSES TO BE WITHDRAWN FROM OPERATING POSITION.
- AT-500-SH = GENERAL ELECTRIC TYPE AIR CIRCUIT BREAKERS.
- KEY INTERLOCKED- THE GROUNDING DISCONNECTS MUST BE CLOSED TO RELEASE THE KEY TO OPEN THE GATE OF THE CHAIN LINK FENCE AROUND THE CAPACITOR BANK.
- H = SUPERVISORY CONTROL FROM SCADA.
- FK-115-500BY = GENERAL ELECTRIC 115 KV AIR CIRCUIT BREAKERS.
- SUPERVISORY CONTROL FROM SCADA.
- 115 KV AIR CIRCUIT BREAKERS WITH CHARGER.
- 115 KV AIR CIRCUIT BREAKERS WITH CHARGER.
- THIS STATION.
- NON-STANDARD BUS POTENTIAL TRANSFORMERS, RATIO 12/111.
- 12/111 = 12/111V/111V. THE TRANSFORMER RATIO FOR THE SEC. 1 TO THE BUS BREAKER AND SEC. 2 AND SEC. 3. THE TRANSFORMER RATIO FOR THE SEC. 1 TO THE BUS BREAKER AND SEC. 2 AND SEC. 3.
- 12/111-PM 115 KV AIR CIRCUIT BREAKER.



BOSTON EDISON COMPANY
DELIVERY ENGINEERING DEPARTMENT
ELECTRICAL DESIGN DRAFTING GROUP

65

DATE	DESCRIPTION	BY	CHKD

2003 T&D OPERATING STUDY WALPOLE DISTRICT

STATION #146 WALPOLE

Walpole Station #146 supplies the towns of Walpole, Sharon, Norfolk and Westwood. In the summer of 2002 Walpole Station #146 load was 81 MVA.

Walpole Station #146 consists of the following transformers:

Transformer #110A: Pennsylvania 30/40 [44.8] MVA 115/14.4 kV

Transformer #110C: Pennsylvania 30/40 [44.8] MVA 115/14.4 kV

Transformer #110D: Westinghouse 16/20 MVA 105 / 13.85 kV

Walpole Street Station #146 has a total capacity of 100 MVA. NSTAR employs summer emergency rating (cyclic capability) for these three banks. Transformers 110A and 110C have a summer emergency rating (cyclic capability) of 50 MVA each. Transformer 110D has a summer emergency rating of 26 MVA. Station #146's firm capacity is 76 MVA. The RADSEC transfer switching capability to adjacent stations is 21.3 MVA. Walpole's load carrying capability is 97.3 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40 [44.8] MVA	55 MVA	51 MVA
110C	30/40 [44.8] MVA	55 MVA	51 MVA
110D	16/20 MVA	31 MVA	28 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
100 MVA	76 MVA	*21.3 MVA	0 MVA	97.3 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
92 MVA	92 MVA	93 MVA	94 MVA	96 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breaker #5 where 110A taps off 447-508 line
Main 110A 13.8kV Circuit Breaker

Close: 13.8 kV Bus Operated Normally Closed
Circuit Breaker #3 to energize transformer #110D

Main 110D 13.8kV Circuit Breaker to connect unit to 13.8kV bus

Loss of Transformer #110C:

Open: Circuit Breaker #1 where 110C taps off 447-509 line
Main #110C 13.8kV Circuit Breaker

Close: 13.8 kV Bus Operated Normally Closed
Circuit Breaker #3 to energize transformer #110D
Main 110D 13.8kV Circuit Breaker to connect unit to 13.8kV bus

Loss of Transformer #110D:

(Transformer is normally out of service and de-energized) During heavy summer load conditions transformer 110D is placed into service.

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Walpole 146-H2 to Medway 65-H1 via RADSEC switches on P 17/41 and P11/43 for a transfer of 5.0 MVA

Walpole 146-H2 to Dover 456-H3 via RADSEC switches on P 1/43 and P22/2 for a transfer of 5.0 MVA

Walpole 146-H6 to Dover 456-H1 via RADSEC switches on P 41/1 and P11/10 for a transfer of 4.2 MVA

Canton 274-H12 to Canton 470-H3 via RADSEC switches on P175/9 and P8/458 for a peak transfer of 3.6 MVA. Walpole 146-H1 to Walpole 146-H3 via RADSEC switches on P18/2 and P99/37 for a peak transfer of 2.9 MVA. These loads are not removed from Walpole Sta #146, however it creates capability for the transfer below.

*Walpole 146-H1 to Canton 470-H12 via RADSEC switches P23/46 for a transfer of 7.1 MVA.

Total Transfer: 21.3 MVA

Summary of Concerns:

1. Inadequate transformer capacity upon the loss of either #146 110A or 110C (2008)

Without any significant major development projects during 2002-2008, the Walpole Supply region is projected to experience very meager load growth; approximately 1.1% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2008 for a single-contingency outage of either transformer 110A or 110C, Walpole Station #146 will exceed the load carrying capability (1% over LTE, 0.3 MVA load risk).

The existing 115/14kV transformers at Walpole, Station #146 are non-regulating transformers. As result of this lack of voltage regulation capability, some of the distribution circuits supplied from Walpole Station #146 experience voltage problems throughout the year. Transformers 110A and 110C normally carry the station load, with 110D assisting during periods of heavy load. This setup, in combination with capacitor banks and regulators on the circuits, mitigate some of the voltage control issues.

To assist with the voltage regulation concerns the Walpole Station #146 operates with all bus ties normally closed.

Distribution Systems

DSS Lines

Walpole Station #146 has three line groups; the Walpole, Clapboardtree, and East Walpole line groups.

The East Walpole Line Group consists of DSS lines 135-1301 and 135-1319H. The line group supplies customer Stations #135. Line 135-1319H has a distribution circuit tapped off the line. Upon the loss of either DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Walpole Line Group consists of three DSS lines 26-1302, 26-1306 and 26-1308. The line group supplies NSTAR Station #26 Stone & Diamond Streets, Walpole and customer station 238. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Clapboardtree Line Group consists of DSS lines 312-1305H and 312-1307XYH. The line group supplies NSTAR Station #312 Clapboardtree Street, Westwood. Both DSS Lines have distribution circuits tapped off the lines. Upon the loss of either DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The East Walpole Line Group consists of DSS lines 135-1301 and 135-1319H. The line group supplies customer Stations #135. Line 135-1319H has a distribution circuit tapped off the line. Upon the loss of either DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The following table provides details on the Walpole Station #146 line groups.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
26-1302	51%	0	0	0	0
26-1306	0%	0	0	0	0
26-1308	83%	0	0	0	0
312-1305H	30%	0	0	0	0
312-1307XY	34%	0	0	0	0
135-1301	12%	0	0	0	0
135-1319	34%	0	0	0	0

Loading on Walpole DSS lines

14 kV Distribution

Walpole's 14 kV distribution circuits show no immediate capacity concerns, since circuit 146-H7 was relieved prior to the summer of 2003. The loading of the 14 kV distribution circuits are shown in the following table. Beginning in 2008, four of the distribution circuits start to reach their full capacity under normal conditions, but the heavy loading concerns can be averted for a few more

years by shifting some of this load to neighboring circuits.

14 kV Circuits	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
146-H1	90%	75%	80%
146-H2	63%	72%	75%
146-H3	98%	85%	90%
146-H4	51%	58%	60%
146-H5	5%	6%	6%
146-H6	79%	89%	93%
146-H7	107%	87%	93%
146-H8	29%	32%	34%
146-H9	83%	94%	99%

Loading on Walpole distribution circuits

4 kV Stations

Walpole #146 feeds two 4 kV stations: Walpole #26 and Westwood #312. The current projects (Westwood High School and High Street underground) will result in the eventual 4 kV to 13.8 kV conversion of at least three of the #312 circuits. The current and projected loading on the 4 kV stations is shown in the following table.

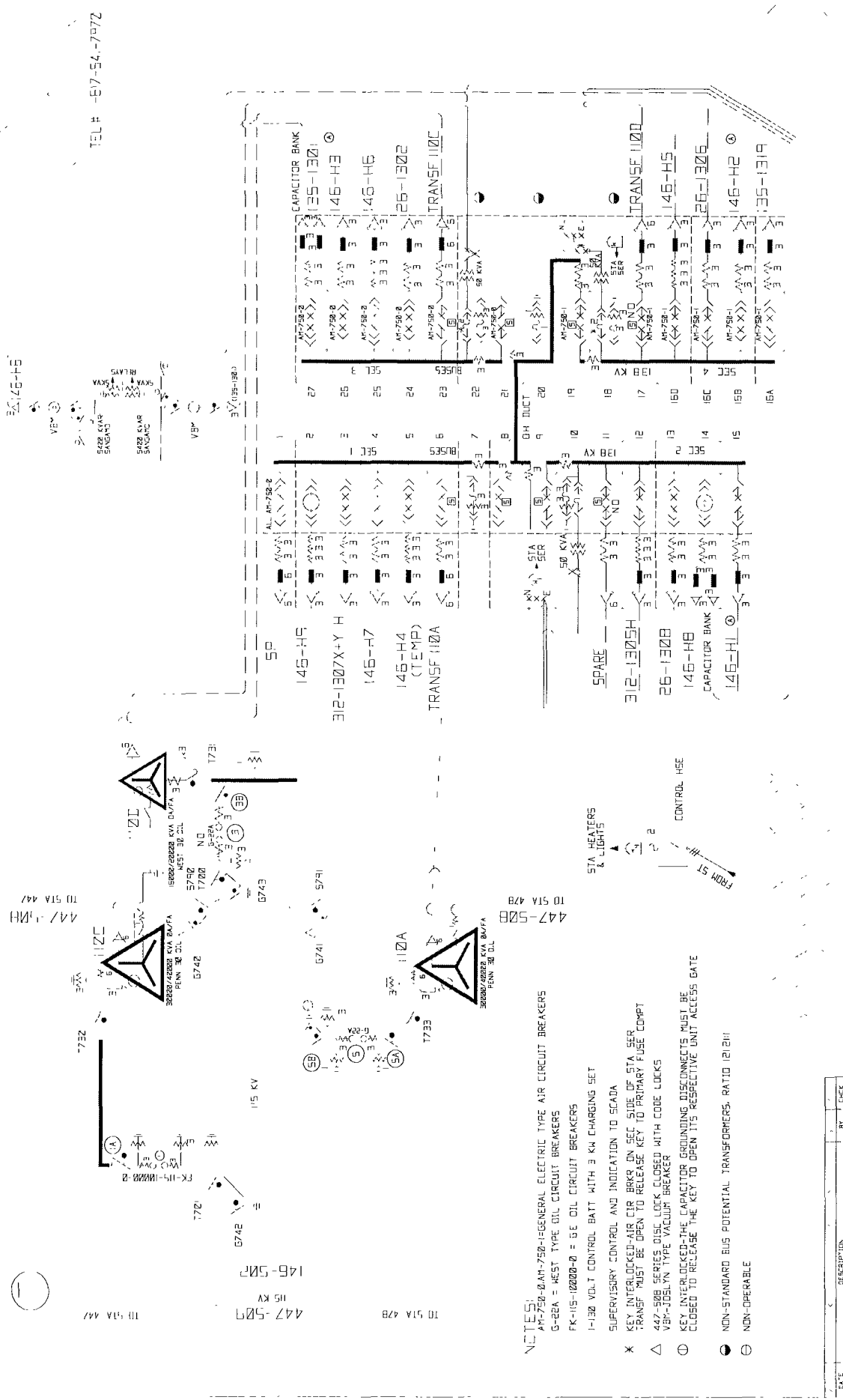
4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Walpole #26	14.5	16.7	14.8	15.4
Westwood #312	4.6	6.0	3.2	3.2

Loading on 4 kV stations fed from Walpole #146

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Walpole supply region. The proposed integrated plan will address the heavy loading conditions, the voltage regulation and the short circuit concerns of Walpole Station #146. The primary focus of the plan will be to increase the transformer capacity at Walpole Station #146 by installing an 18/24 MVA 115/14 kV LTC transformer (i.e. Chelsea Sta #488 Transformer 110D) to Bus section #2. The second component of the plan is to install a Programmable Logic Controller to establish an Auto Bus Restoral system that will address the short circuit concerns. The additional transformer capability will provide the foundation for all the Walpole supply region's capacity needs beyond 2008. The DSS and 14 kV distribution infrastructure has sufficient capability to support the anticipated increase in load.

Action	Year needed	Cost
⇒ Install fourth transformer and ABR scheme at Walpole #146 or relieve the station via load transfers to adjacent stations	2005	TBD



- NOTES:
- AM-750-0/AM-750-1 GENERAL ELECTRIC TYPE AIR CIRCUIT BREAKERS
 - G-22A = WEST TYPE OIL CIRCUIT BREAKERS
 - FK-115-10000-0 = 5E OIL CIRCUIT BREAKERS
 - 1-130 VOLT CONTROL BATT WITH 3 KW CHARGING SET
 - SUPERVISORY CONTROL AND INDICATION TO SCADA
 - * KEY INTERLOCKED-AIR CIR BRKR ON SEC SIDE OF STA SER TRANSF MUST BE OPEN TO RELEASE KEY TO PRIMARY FUSE COMPT
 - △ 447-508 SERIES DISC LOCK CLOSED WITH CODE LOCKS
 - VBI-JOSLYN TYPE VACUUM BREAKER
 - KEY INTERLOCKED-THE CAPACITOR GROUNDING DISCONNECTS MUST BE CLOSED TO RELEASE THE KEY TO OPEN ITS RESPECTIVE UNIT ACCESS GATE
 - NON-STANDARD BUS POTENTIAL TRANSFORMERS, RATIO 121/211
 - NON-OPERABLE

DATE	DESCRIPTION	BY	CHK

2003 T&D OPERATING STUDY WALPOLE DISTRICT

STATION #456 DOVER

Dover Station #456 serves a power supply area consisting of portions of the towns of Dover, Westwood, Medfield and Walpole. In the summer of 2002 the Dover Station #456 load was 25 MVA.

Dover Station #456 consists of the following transformer:

Transformer #110A: Westinghouse 18/24 MVA 110/13.8 kV

Dover Station #456 has a total capacity of 24 MVA. Dover is a single 115/14 kV transformer and has no firm capacity. The RADSEC transfer switching capability to adjacent stations is 23.2 MVA. Dover's load carrying capability is 23.2 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	18/24 MVA	36 MVA	32 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
24 MVA	0 MVA	23.2 MVA	0 MVA	23.2 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
30 MVA	30 MVA	30 MVA	31 MVA	31 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breaker #1 on 115kV bus
Main 110A 13.8kV Circuit Breaker

Close: Transfer 13.8kV circuits to adjacent stations as listed below:

Framingham 240-H5 to Needham 148-H3 via RADSEC switches on P10/135 and P15/24 for a peak transfer of 1.7 MVA. This load is not removed from Dover Sta #456, however it creates capability for the transfer below.

Dover 456-H3 to Framingham 240-H5 via RADSEC switch on P4/46 and Walpole 146-H2 via

RADSEC switch for a total transfer of 10.6 MVA

Dover 456-H2 to Walpole 146-H6 via RADSEC switch on P41/1 for a transfer of 6.0 MVA

Dover 456-H1 to Walpole 146-H4 via RADSEC switch on P3/26 for a transfer of 6.6 MVA

Total Transfer: 23.2 MVA

Summary of Concerns:

1. Inadequate transfer capability to adjacent stations for the loss of Dover Station #456 transformer (2004)
2. Overloading on circuits 456-H2 and 456-H3 (2004 – 2008)

Based on load projections by the summer of 2004 for the loss of the Dover Station #456 transformer, Dover Station #456 will exceed the transfer switching capability to the adjacent stations. The new load will strain the capability of Dover #456 substation and distribution infrastructure to support the customer load requirements. With the planned load increase, the region's 2004 projected load of 30 MVA would exceed the capability of Dover Station #456. The load at risk is 6.8 MW.

Distribution Systems

14 kV Distribution Circuits

Dover #456 only has four radial distribution circuits, one of which will not carry significant load until 2004. Line 456-H3, which was overloaded under normal conditions in the summer of 2002, has been upgraded prior to the summer 2003. The revised rating of 456-H3 has been factored into the 2004 projected loading. The Dover load forecast for 2004 and 2008 is extremely aggressive and may not materialize this quickly as forecasted.

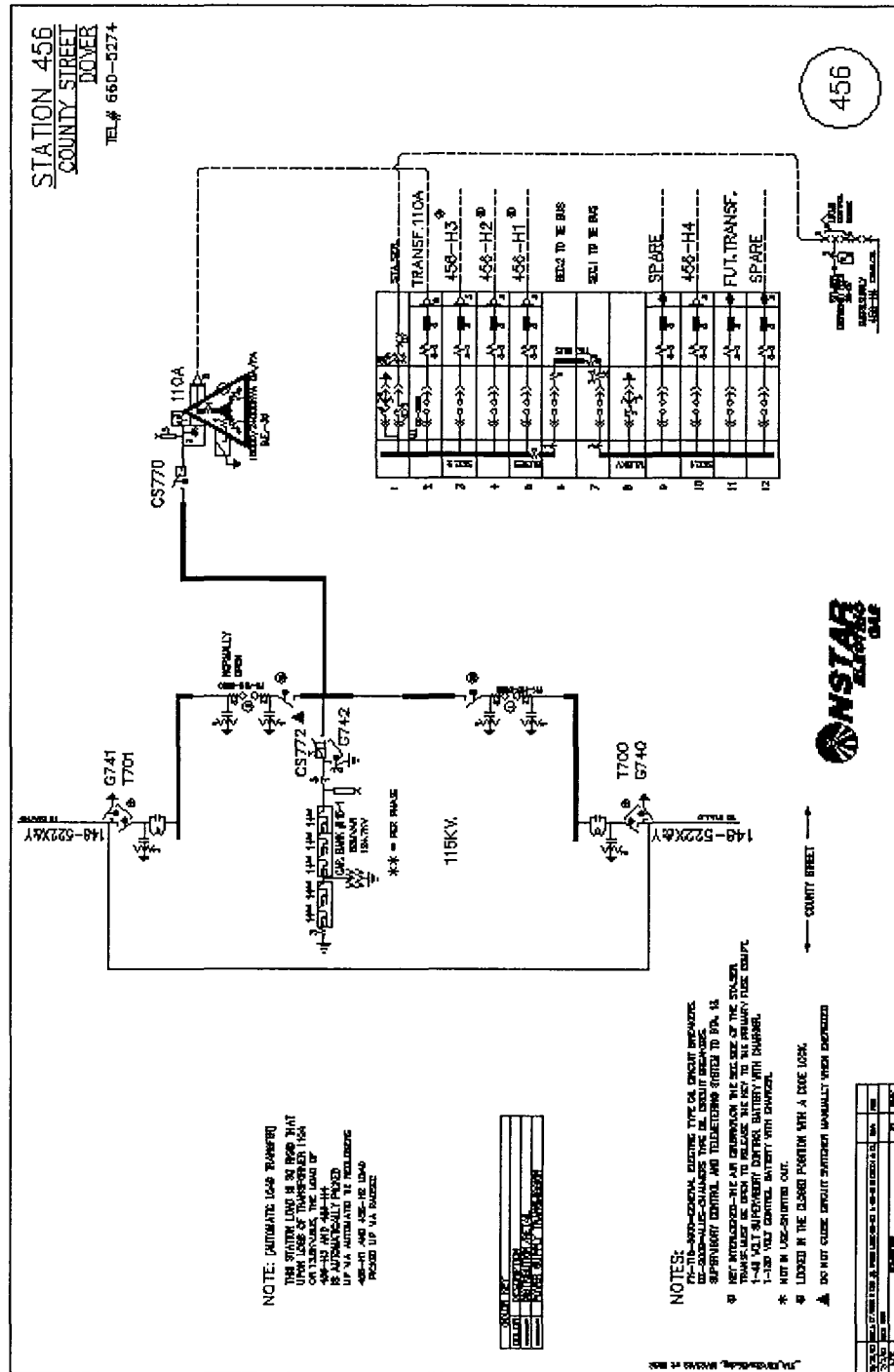
14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
456-H1	82%	77%	80%
456-H2	89%	107%	111%
456-H3	110%	98%	102%
456-H4	1%	43%	45%

Loading on Dover distribution circuits

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Dover supply region. The primary focus of the plan will be to establish firm capacity at Dover Station #456 by installing a second 115/14 KV transformer and to replace the existing sections of distribution switchgear. The second transformer will provide the foundation for all the Dover area capacity needs beyond 2008. The new distribution switchgear will provide spare feeder positions for new circuits that would relieve the heavily loaded 14 kV distribution circuits and to increased transfer switching between Dover, Walpole, Framingham and Needham.

Action	Year needed	Cost
⇒ Establish a double-ended station at Dover #456	2004	\$3.0Mil
⇒ Install a new distribution circuit at Dover #456 to relieve 456-H2	2004	\$650K



2003 T&D OPERATING STUDY WALPOLE DISTRICT

STATION #470 CANTON

Canton Station #470 serves a power supply area consisting of the entire town of Canton and portions of the towns of Westwood and Walpole. In the summer of 2002 the Canton Station #470 load was 87 MVA.

Canton Station #470 consists of the following transformers:

Transformer #110A: McGraw-Edison 24/32/40 MVA 115/13.8 kV

Transformer #110B: Westinghouse 30/40 MVA 103.95 / 13.8 kV

Transformer #110C: Westinghouse 30/40 MVA 103.95 / 13.8 kV

Canton Station #470 has a total capacity of 120 MVA. NSTAR employs summer emergency rating (cyclic capability) for these three banks. Transformer 110A has a summer emergency rating of 41 MVA. Transformers 110B and 110C have a summer emergency rating (cyclic capability) of 48 MVA each.

Canton is limited in firm capacity by the impedance of the transformers. Transformers 110B and 110C are 9.8% impedance on a 30 MVA base, while transformer 110A is 15% impedance on a 24 MVA base. Under normal operating conditions, this does not present a problem, since all bus ties are open. However, should transformer 110B or 110C come out of service, the bus ties will close, and the lower impedance transformer will absorb a proportionally higher amount of load. This fact, in effect, reduces the firm capacity of the station. Station #470's firm capacity is 89 MVA.

The RADSEC transfer switching capability to adjacent stations is 16.6 MVA. Canton's load carrying capability is 105.6 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	24/32/40 MVA	48 MVA	44 MVA
110B	30/40 MVA	56 MVA	52 MVA
110C	30/40 MVA	56 MVA	52 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
120 MVA	89 MVA	16.6 MVA	0 MVA	105.6 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
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95 MVA	95 MVA	96 MVA	97 MVA	99 MVA
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Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS770

Main 110A 13.8kV Circuit Breaker

Close: ABR scheme closes 13.8V bus tie breakers automatically *

Loss of Transformer #110B:

Open: Circuit Switcher #CS771

Main 110B 13.8kV Circuit Breaker

Close: ABR scheme closes 13.8V bus tie breakers automatically *

Loss of Transformer #110C:

Open: 115kV Circuit Breaker #5

Main 110C 13.8kV Circuit Breaker

Close: ABR scheme closes 13.8V bus tie breakers automatically *

*Note: ABR scheme modes of operation, from Station 470 Canton 1-line diagram:

ABR SEQUENCE OF OPERATION

Condition, Loss of>>	447-508	447-509	T110A	T110B	T110C	447-509 Mode Normal	447-508 MODE Normal
OCB 2	Open	Closed	Open	Open	Open	Open	Closed
OCB 5	Closed	Open	Closed	Closed	Open	Closed	Open
CS 770	Closed	Open	Open	Closed	Closed	Closed	Closed
CS 771	Open	Closed	Closed	Open	Closed	Closed	Closed
110A to Section 1	Closed	Open	Open	Closed	Closed	Closed	Closed
110B to Section 2	Open	Closed	Closed	Open	Closed	Closed	Closed
110C to Section 3	Closed	Closed	Closed	Closed	Open	Closed	Closed
Section 1 to Tie	Open	Closed	Closed	OPEN	Open	Open	Open
Section 2 to Tie	Closed	Closed	Closed	Closed	Closed	Open	Open
Section 3 to Tie	Closed	Closed	Closed	Closed	Closed	Closed	Closed

For loss of any transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Canton 470-H1 to Baker Street 110 via Station 20-H3 via a RADSEC switch on P1/7 for a transfer of 6.8 MVA.

Canton 470-H5 to Walpole 135-1319H via a RADSEC switch on P6/18 for a transfer of 6.6 MVA.

Canton 470-H7 to Hyde Park 496-H2 via RADSEC switches on P1/26 and P1/217 for a transfer of 3.2 MVA.

Total Transfers: 16.6 MVA

Summary of Concerns:

1. DSS line 269-1320H is overloaded under normal conditions (2004)
2. DSS lines 269-1321H and 47-1311 overload under contingency conditions (2004)
3. Heavy Loading conditions on several distribution circuits (2008)

Without any significant major development projects during 2002-2008, the Canton Supply region is projected to experience very meager load growth; approximately 1% annual load growth. As a result of this small load growth based on load projections, by the summer of 2008 for a single-contingency outage of either transformer 110B or 110C, Canton Station #470 will be heavily loaded at 94% of the load carrying capability, there is no load at risk.

Distribution Systems

DSS Lines

Canton supplies the Draper/Plymouth line group.

The **Draper Plymouth Line Group** consists of three DSS lines 269-1320H, 269-1321H and 47-1311. The line group supplies both the Draper Brothers Customer Station #269 and customer station #47-2. Line 269-1320H exceeds its normal capacity. Since it can no longer accept load in the event of the loss of one of the other two lines, there is a substantial amount of load at risk in 2004. As shown in the following table upon the loss of either 269-1320H and 47-1311 the remaining DSS lines will exceed the long term emergency (LTE) capacity based on 2004-2008 load projections.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
269-1320H	113%	0	0		0
269-1321H	53%	37%	1.7	47%	1.4
47-1311	25%	51%	0.9	76%	2.2

Loading on Canton DSS lines

14 kV Distribution circuits

The twelve distribution circuits fed from Canton #470 will have adequate capacity. By 2008 four circuits are projected to be 95%- 100% of its normal capacity with all lines in service. There are no 4 kV stations/circuits fed from this station.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
470-H1	83%	83%	86%
470-H2	25%	25%	26%
470-H3	98%	93%	97%
470-H4	83%	83%	87%
470-H5	77%	77%	80%

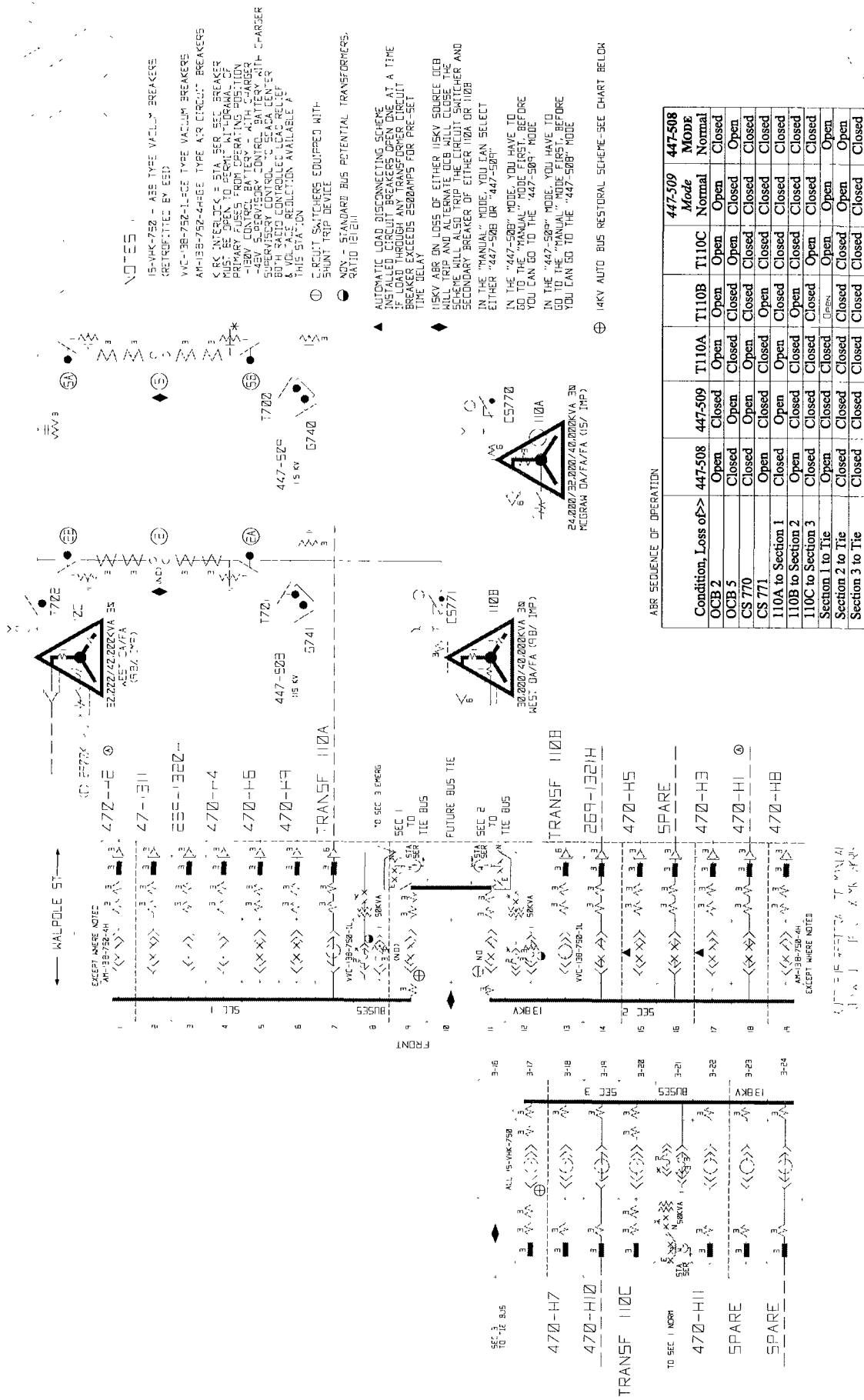
470-H6	18%	18%	19%
470-H7	91%	91%	95%
470-H8	95%	95%	99%
470-H9	92%	92%	96%
470-H10	71%	71%	74%
470-H11	65%	65%	68%
470-H12	(new)	80%	80%

Loading on Canton distribution circuits

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Canton supply region. Canton Station #470 has adequate transformer capacity and transfer switching to adjacent stations to support the projected meager load growth beyond 2008. Canton Station #470 has three spare feeder positions that can support the installation of new distribution circuits that would relieve the heavily loaded Draper/Plymouth line group and the 14 kV distribution circuits. Alternatives include increase the capacity of the distribution circuits by reconductoring and cascading load transfers to adjacent circuits in the Canton supply region.

Action	Year needed	Cost
⇒ Install a new distribution circuit at Canton #470 to relieve existing Canton #470 circuits and Draper/Plymouth line group	2004	\$600K
⇒ Install a new distribution circuit at Canton #470 or reconductor two Canton Station #470 distribution circuits or load transfers to adjacent circuits in the Canton supply region.	2008	TBD



ASR SEQUENCE UP- PERATION	447-508				447-509				447-510				447-511				447-512				447-513				447-514				447-515				447-516				447-517				447-518				447-519				447-520				447-521				447-522				447-523				447-524				447-525				447-526				447-527				447-528				447-529				447-530				447-531				447-532				447-533				447-534				447-535				447-536				447-537				447-538				447-539				447-540				447-541				447-542				447-543				447-544				447-545				447-546				447-547				447-548				447-549				447-550				447-551				447-552				447-553				447-554				447-555				447-556				447-557				447-558				447-559				447-560				447-561				447-562				447-563				447-564				447-565				447-566				447-567				447-568				447-569				447-570				447-571				447-572				447-573				447-574				447-575				447-576				447-577				447-578				447-579				447-580				447-581				447-582				447-583				447-584				447-585				447-586				447-587				447-588				447-589				447-590				447-591				447-592				447-593				447-594				447-595				447-596				447-597				447-598				447-599				447-600				447-601				447-602				447-603				447-604				447-605				447-606				447-607				447-608				447-609				447-610				447-611				447-612				447-613				447-614				447-615				447-616				447-617				447-618				447-619				447-620				447-621				447-622				447-623				447-624				447-625				447-626				447-627				447-628				447-629				447-630				447-631				447-632				447-633				447-634				447-635				447-636				447-637				447-638				447-639				447-640				447-641				447-642				447-643				447-644				447-645				447-646				447-647				447-648				447-649				447-650				447-651				447-652				447-653				447-654				447-655				447-656				447-657				447-658				447-659				447-660				447-661				447-662				447-663				447-664				447-665				447-666				447-667				447-668				447-669				447-670				447-671				447-672				447-673				447-674				447-675				447-676				447-677				447-678				447-679				447-680				447-681				447-682				447-683				447-684				447-685				447-686				447-687				447-688				447-689				447-690				447-691				447-692				447-693				447-694				447-695				447-696				447-697				447-698				447-699				447-700				447-701				447-702				447-703				447-704				447-705				447-706				447-707				447-708				447-709				447-710				447-711				447-712				447-713				447-714				447-715				447-716				447-717				447-718				447-719				447-720				447-721				447-722				447-723				447-724				447-725				447-726				447-727				447-728				447-729				447-730				447-731				447-732				447-733				447-734				447-735				447-736				447-737				447-738				447-739				447-740				447-741				447-742				447-743				447-744				447-745				447-746				447-747				447-748				447-749				447-750				447-751				447-752				447-753				447-754				447-755				447-756				447-757				447-758				447-759				447-760				447-761				447-762				447-763				447-764				447-765				447-766				447-767				447-768				447-769				447-770				447-771				447-772				447-773				447-774				447-775				447-776				447-777				447-778				447-779				447-780				447-781				447-782				447-783				447-784				447-785				447-786				447-787				447-788				447-789				447-790				447-791				447-792				447-793				447-794				447-795				447-796				447-797				447-798				447-799				447-800				447-801				447-802				447-803				447-804				447-805				447-806				447-807				447-808				447-809				447-810				447-811				447-812				447-813				447-814				447-815				447-816				447-817				447-818				447-819				447-820				447-821				447-822				447-823				447-824				447-825				447-826				447-827				447-828				447-829				447-830				447-831				447-832				447-833				447-834				447-835				447-836				447-837				447-838				447-839				447-840				447-841				447-842				447-843				447-844				447-845				447-846				447-847				447-848				447-849				447-850				447-851				447-852				447-853				447-854				447-855				447-856				447-857				447-858				447-859				447-860				447-861				447-862				447-863				447-864				447-865				447-866				447-867				447-868				447-869				447-870				447-871				447-872				447-873				447-874				447-875				447-876				447-877				447-878				447-879				447-880				447-881				447-882				447-883				447-884				447-885				447-886				447-887				447-888				447-889				447-890				447-891				447-892				447-893				447-894				447-895				447-896				447-897				447-898				447-899				447-900				447-901				447-902				447-903				447-904				447-905				447-906				447-907				447-908				447-909				447-910				447-911				447-912				447-913				447-914				447-915				447-916				447-917				447-918				447-919				447-920				447-921				447-922				447-923				447-924				447-925				447-926				447-927				447-928				447-929				447-930				447-931				447-932				447-933				447-934				447-935				447-936				447-937				447-938				447-939				447-940				447-941				447-942				447-943				447-944				447-945				447-946				447-947				447-948				447-949				447-950				447-951				447-952				447-953				447-954				447-955				447-956				447-957				447-958				447-959				447-960				447-961	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